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ABSTRACT

This paper reports a study which investigated student characteristics for predicting success in an independent, open laboratory. Data were gathered from introductory biology students (N=98) enrolled in a public, two-year college near Atlanta, Georgia. Stepwise multiple regression analysis was used to determine the effects of age, sex, laboratory preparedness, lecture achievement, college grade point average, and time on success in the laboratory. Comparisons were made to the factors that predicted success in the non-individualized portion of the course. (Author/CS)

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WHO SUCCEEDS IN AN INDEPENDENT, OPEN LABORATORY?

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Who Succeeds in an Independent, Open Laboratory?

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On-going analysis, assessment, and revision of programs is a vital component of any academic setting. The process is especially critical to individualized systems which purport to conform to needs of each and every student. The extent of student achievement, i.e. achievement of objectives, must be determined as an integral part of the study. Quite as critical is the analysis of environmental variables of the program under scrutiny and the extent to which these variables affect student achievement. When studying an individualized system it is important to include for study factors that researchers have shown to have influenced achievement in similar programs.

The results of an on-going analysis of an individualized biology laboratory are given in this report. The purpose of the study was to analyze the laboratory with respect to achievement of laboratory objectives and factors related to success in the laboratory. Knowledge of factors related to success can then be used to aid students not achieving the objectives at the desired level. The individualized laboratory is a required component of a two-quarter introductory biology sequence in a metropolitan area junior college. The lecture portion of the sequence is not individualized and from this students should gain knowledge of facts and principles of biology. In the laboratory, students are expected to

develop observational competence and to apply the facts and principles of biology in a variety of investigative situations.

The individualized laboratory is open 26 hours per week. Students sign-in and sign-out of the laboratory at their convenience; they may work alone or in groups for as long as needed to meet the objectives for a particular week. Objectives and detailed procedures are specified in the laboratory manual; more precise procedural guidelines are available in the audiovisual format (sound-slide and film loops). A detailed description of the purpose of this individualized laboratory has been reported (Lam, Halyard, and Walter, 1972).

Preliminary data were gathered from 78 students enrolled in the second quarter of the two-quarter sequence. The model for the analysis was patterned after Astin and Panos (1971) using Method III, measurement of operations and outcomes. Achievement of laboratory objectives was used as a measure of output. Educational operations were described by showing the influence on laboratory achievement of factors identified in the literature as predictors of success in individualized methods of instruction. Results of this preliminary analysis have been previously reported (Halyard, Pridmore, and Carpenter, 1979).

As a result of findings in the preliminary study and in the literature (Bish, Bowman, and Sarachek, 1978; Fisher and MacWhinney, 1976; Fisher et al., 1977; Maccini, 1969; McClurg, 1971; McDuffie and Bruce, 1980; Steffen, 1971), the following factors were included for the next study: time spent in lab, lecture achievement, age, sex, major, college grade point average, laboratory pretest score, and academic motivation. Laboratory pretests were designed to guide weaker students in the use of the laboratory; the pretest was a short answer written test that required knowledge of facts, principles, materials, and procedures to be used in a particular laboratory. To prepare for the pretest students were told to study the laboratory manual and objectives carefully. Similar tests

have been shown to positively influence student cognitive achievement (Goodson and Okey, 1978). The Academic Motivations Inventory (Doyle and Moen, 1978) was administered to the students the last week of the quarter and was analyzed to reveal the subscores on the 16 measurable motivations of the test (see Table I). These subscores were subsequently studied as predictors of laboratory achievement. Data relevant to factor analysis, reliability, and validity of the instrument are available in the literature (Doyle and Moen, 1978).

Achievement of Laboratory Objectives

Data were gathered from 98 students (science majors and non-majors) enrolled in the first quarter of the two-quarter sequence. Examinations included identification of materials from 2x2 color slides and photomicrographs, drawing conclusions from mock experiments similar to those in the laboratory, and explaining phenomena observed in the laboratory. Two laboratory posttests were administered during the quarter, each testing for different objectives. Each student's laboratory grade for the analysis was recorded as the sum of the points from the two separate tests. The mean laboratory grade was 53.84 (80 point maximum) with a standard deviation of 12.28. This score indicates that the objectives of the laboratory are achieved by most students, although the large standard deviation is evidence of a heterogeneous population with respect to achievement in the laboratory. A frequency distribution of scores revealed that 54 percent of the students achieved at the 70 percent or higher level.

Factors Related to Success in the Laboratory

Stepwise multiple regression analysis was used to determine the relationship between success in the individualized laboratory and the following factors:

1. Lecture achievement (in total points) as a measure of knowledge of facts and principles of biology,

2. Time spent in the laboratory, as indicated on the sign-in and sign-out report sheets,
3. Age of the student,
4. Sex of the student,
5. Major of the student (science or non-science),
6. College grade point average (GPA),
7. Laboratory pretest scores (in total points),
8. Academic motivation as measured on 16 subtests of the Academic Motivations Inventory (AMI) (Doyle and Moen, 1978).

The BMD-02R computer program was used for the analysis. The data were gathered from 88 students for whom all information needed for the independent variables was available. A description of the sample with respect to independent and dependent variables is given in Table II.

Results of multiple regression analysis where the laboratory posttest is the dependent variable are given in Table III. Three significant predictors of success in the laboratory were detected; these accounted for 71 percent of the total variance in the laboratory posttest scores. The predictors, in the order in which they enter the equation are: lecture grade ($F = 81.50$, $p < .01$), time spent in the lab (negative regression coefficient; $F = 58.35$, $p < .01$), and achieving motives ($F = 4.82$, $p < .05$).

A separate regression analysis was conducted to identify predictors of time spent in the laboratory. Results are shown in Table IV. Three significant predictors accounting for 73 percent of the variance were found. The predictors, in the order in which they enter the equation, are: lab pretest ($F = 92.99$, $p < .01$), lab posttest score (negative regression coefficient, $F = 50.52$, $p < .01$), and disliking school (negative regression coefficient, $F = 9.56$, $p < .01$).

Selected data from the correlation matrix are given in Table V.

Discussion

The results of this study indicate that 54 percent of the students achieved the laboratory objectives at the 70 percent or higher level. This indicates that while the conditions in the individualized laboratory and the instructional strategies used were suitable for the majority of students, the needs of many are not being met. Insight into these needs can be gained by studying the variables that predict success in the laboratory. Multiple regression analysis revealed that lecture achievement, which is primarily a measure of knowledge of facts and principles, predicts most variance in lab posttest scores (49 percent). Because the laboratory is designed for students to apply the facts and principles of biology in investigative situations, it is reasonable that the high achievers would be students who have higher lecture grades and therefore a greater knowledge of facts and principles. Increasing student performance in lecture should therefore increase their laboratory performance.

Time spent in the laboratory is a negative predictor of success on the laboratory posttest and accounts for 21 percent of the variance in the grades. A possible explanation for this finding is that students are not directing their time to the tasks in such a way that their grades improve. Although pretests were designed to guide students in the use of their time, findings show that pretest scores do not predict the students' performance on lab tests and apparently measure another aspect of their learning. This is possibly the result of the construction of the pretest and the posttest that determined the laboratory grade. The pretest did not require visual identification or data interpretation, the major requirements of the posttest. Students apparently did not spend their time learning to identify and discriminate between biological materials or extrapolating from the data gathered in their experiments.

Analysis of factors that predict time spent in lab revealed that the lab

pretest score predicts 52 percent of the variance of the time spent in lab. A high pretest score tends to direct the students to spend more time, but does not direct them in wise use of time. The high correlation ($r = 0.72$) between lab pretest and the time spent in lab indicates that some common influence is directing the students' performance with respect to these two variables. This influence does not extend, however, to their performance on the posttest. Again, the common influence might well be test construction.

The correlation matrix indicates a significant positive correlation between the lecture grade and time spent in lab ($r = 0.22$, $p < .05$), lab pretest ($r = 0.61$, $p < .01$), and lab posttest ($r = 0.70$, $p < .01$). These data further indicate that students spend their time in the individualized lab studying for the kinds of questions or facts that are found on lecture tests or lab pretests. Therefore even strong lecture students might spend time unwisely in lab.

Consistent with findings of other researchers, motivation variables are found to be significant predictors of success in the individualized learning system. Motivation to work hard and do one's best accounted for two percent of the variance on the lab posttest. This finding is not surprising. Multiple regression analysis showed that disliking or lacking interest in school caused students to spend less time in the lab. It is interesting to note that the correlation matrix showed a significant negative correlation between disliking school and grade on the laboratory posttest ($r = -0.28$, $p < .01$). It appears that disliking school tends to cause students to spend less time and perform poorly in the laboratory. These data are another indication that the observed relationship between time and laboratory success has to do with misused time and unfamiliar testing rather than with lack of student aptitude.

Summary

The analysis of the individualized laboratory revealed the following:

1. Fifty-four percent of the students achieved the laboratory objectives at the 70 percent level. Efforts to increase achievement should be directed at those variables shown to influence laboratory achievement.
2. Students who have acquired the knowledge of biological facts and principles in the non-individualized lecture achieve most in the individualized lab.
3. Students who spend long periods of time in the lab are likely to score poorly on the laboratory posttest.
4. Students who spend more time in the lab are most likely students who are achievers on the laboratory pretests and lecture tests. There is therefore an indication that students are not efficiently using the time available in the individualized lab.
5. Achievement oriented students are likely to succeed in the laboratory.
6. Students who dislike school are likely to spend less time in the lab and score low on the laboratory posttest.

LITERATURE CITED

Astin, A. W. and Panos, R. J. The evaluation of educational programs. In R. L. Thorndike (Ed.), Educational measurement, (2nd ed.). Washington: American Council on Education, 1971.

Bish, J. T., Bowman, Barbara L., and Sarachek, A. Lecture-laboratory vs structured audio-tutorial approaches: student achievement. Journal of College Science Teaching, 1978, 7(3): 168-171.

Doyle, K. O. and Moen, Ross E. Toward a definition of a domain of academic motivation. Journal of Educational Psychology, 1978, 70(2): 231-236.

Fisher, K. M. et al. Does video-autotutorial instruction improve college student achievement? Journal of Research in Science Teaching, 1977, 14(6): 481-498.

Fisher, K. M. and MacWhinney, B. AV autotutorial instruction: a review of evaluative research. AV Communication Review, 1976, 24(2), 229-261.

Goodson, M. L. and Okey, J. R. The effects of diagnostic tests and help sessions on college science achievement. Journal of College Science Teaching, 1978, 8(2): 89.

Halyard, R. A., Pridmore, B. M., and Carpenter, C. B. An analysis of an individualized biology laboratory in a junior college. Paper presented for the International Congress for Individualized Instruction, Athens, 1979, (ED 178364).

Lam, O. C., Halyard, R. A., and Walter, S. B. Group audio-tutorial instruction. A.I.B.S. Educational Division News, 1972, 1(2): 6-7.

Maccini, J. A. Evaluation of an audio-visual tutorial laboratory serving college level introductory geology. (Doctoral dissertation, Ohio State University, 1969). Dissertation Abstracts International, 1970, 30, 2872A - 2873A. (University Microfilms No. 69-22, 171).

McClurg, J. E. The development and experimental evaluation of an open-scheduled auto-tutorial geology laboratory. (Doctoral dissertation, University of Michigan, 1971). Dissertation Abstracts International, 1971, 32, 1358A. (University Microfilms No. 71-23, 823).

McDuffie, Thomas E. and Bruce, Matthew H. Predicting achievement and success in an AT biology program. Journal of Research in Science Teaching, 1980, 17(5), 449-454.

Steffen, R. F. Unobtrusive observation of student non-verbal behavior in audio-tutorial self-instruction. (Doctoral dissertation, Syracuse University, 1971). Dissertation Abstracts International, 1972, 32, 5678A - 5679A. (University Microfilms No. 72-11, 867).

TABLE I

SIXTEEN MEASURABLE ACADEMIC MOTIVATIONS

Thinking Motives	Demanding
Persisting Motives	Influencing Motives
Achieving Motives	Competing Motives
Facilitating Anxiety	Approval Motives
Debilitating Anxiety	Affiliating Motives
Grades Orientation	Withdrawing Motives
Economic Orientation	Dislike School
Desire For Self-Improvement	Discouraged About School

TABLE II

DESCRIPTION OF THE SAMPLE WITH RESPECT TO SELECTED VARIABLES USED IN THE MULTIPLE REGRESSION STUDY

VARIABLES	SCALE RANGE	MEAN	S. D.
LECTURE ACHIEVEMENT	0 - 480	352.57	63.60
LAB POSTTEST	0 - 30	54.50	12.01
LAB PRETEST	0 - 40	29.50	8.91
AGE	ACTUAL (YEARS)	21.78	7.42
COLLEGE GPA	0 - 4.00	2.10	0.77
MAJOR	0: NON-SCIENCE 1: SCIENCE	0.25	0.43
SEX	0: MALE 1: FEMALE	0.58	0.50

NOTE: N = 88

TABLE III

MULTIPLE CORRELATION OF LECTURE ACHIEVEMENT, TIME SPENT IN LAB, AND ACHIEVING MOTIVES WITH LABORATORY POSTTEST

	MULTIPLE R	R^2	F
LECTURE ACHIEVEMENT	0.70	0.49	81.50**
LAB TIME	0.83	0.70	58.35**
ACHIEVING MOTIVES	0.84	0.71	4.82*

NOTE: N = 88

**F(1,84) = 6.96, P < .01
*F(1,84) = 3.96, P < .05

TABLE IV

MULTIPLE CORRELATION OF LABORATORY PRETEST, LABORATORY POSTTEST, AND DISLIKING SCHOOL WITH TIME SPENT IN LAB

	MULTIPLE R	R^2	F
LAB PRETEST	0.72	0.52	92.99*
LAB POSTTEST	0.84	0.70	50.52*
DISLIKING SCHOOL	0.85	0.73	9.57*

NOTE: N = 88 *$F(1,84) = 6.96$, $P < .01$

TABLE V

INTERCORRELATIONS AMONG PREDICTOR AND DEPENDENT VARIABLES USED IN MULTIPLE REGRESSION ANALYSIS*

	LECTURE ACHIEVEMENT	LAB POSTTEST	LAB PRETEST	COLLEGE GPA	DISLIKE SCHOOL	ACHIEVEMENT MOTIVATION	LAB TIME
LECTURE ACHIEVEMENT	---	0.70	0.61	0.77	-0.38	0.50	0.22
LAB POSTTEST		---	0.17	0.61	-0.28	0.37	-0.29
LAB PRETEST			---	0.44	-0.21	0.35	0.72
COLLEGE GPA				---	-0.27	0.42	0.14
DISLIKE SCHOOL					---	-0.39	-0.21
ACHIEVEMENT MOTIVATION						---	0.25
LAB TIME							---

*N = 88. IF COEFFICIENT EQUALS 0.21 OR MORE, $p < .05$